Sys*Stim® 206A

MAINTENANCE MANUAL

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TABLE OF CONTENTS

Subject	Page
Introduction	3
Abbreviations	3
Labels	3
Specifications	4
Precautions	5
Equipment Description	6
Control Panel Description	8
Theory of Operation	12
Operating Instructions	14
Routine Maintenance	16
Fuse Replacement	16
Troubleshooting Guide	16
Test Procedures	18
Waveform Diagrams	24
Parts List	25
Sys*Stim 206A Accessory List	31
Drawings and Schematics	32

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INTRODUCTION

Sys*Stim 206A servicing should be done at the factory.

If not possible to return the Sys*Stim 206A to the factory, this service manual may be used to troubleshoot to the major subassembly level. Discrepant subassemblies can then be repaired at the factory as an alternative to returning the complete system.

This manual is intended for service technicians who perform preventive and corrective maintenance on medical devices using appropriate electronic test and measurement equipment. It should be read in its entirety before attempting to service the Sys*Stim 206A.

For technical assistance, call our Service Department at:

Toll Free: (800) 854–9305, USA
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ABBREVIATIONS

AC - alternating current
DC - direct current
DVM - digital voltmeter
Hz - Hertz (cycles per second)
kohm - Kilo-ohm (1000 ohms)
mA - milliampere (1/1000 ampere)
msec - millisecond (1/1000 second)
mW - milliwatt (1/1000 watt)
µsec - microsecond (1/1,000,000 second)
Vdc - Voltage direct current
Vac - Voltage alternating current
W - watts
Recip - Reciprocation

LABELS

The Food and Drug Administration (FDA) requires that medical devices be uniquely identifiable. To comply with this requirement, the Sys*Stim 206A has a serialized label unique to each unit.

Please be careful not to damage these labels, especially during servicing actions such as removing and replacing enclosures.

Include serial numbers when requesting technical assistance.

SPECIFICATIONS

Line input: 115 VAC (± 10%), 50/60 Hz

UL listed: Model 206A (Type# 737K)

Output:

Volts:	0 - 102 V
Milliamps:	0 - 30 mA DC Continuous
	0 - 200 mA (into 500 ohm load)
	Narrow pulse
	Wide pulse
	AC

Waveform Type:

Narrow Pulse	Asymmetrical Biphasic Square
Wide Pulse	Asymmetrical Biphasic Square
AC	Symmetrical Biphasic Square
DC Continuous	Continuous DC
P1, P5, P10	Monophasic Square

Frequency: 1 - 83 pps (Narrow, Wide, AC Pulses or P1, P5 OR P10 "DC Continuous" waveforms)

SURGE Modes:

Narrow, wide, and AC pulses

All up/down ramps fixed at 3 Seconds

F35	6 sec. on	18 sec. off	(35 pps)
F83	6 sec. on	18 sec. off	(83 pps)
On/Off	1-60 sec.	1-60 sec.	(1-83 pps)

Reciprocation Time: 2 - 10 seconds

Fuse: 1 Amp, Fast acting

Treatment Timer Specifications:

Indicator:

The digital time indicator displays set time in minutes and seconds prior to the start of operation, and time remaining during operation and while in HOLD. Time is measured during operation only.

Accuracy:	± 0.5 minute (at all settings.)
Maximum setting:	29 minutes (preset)
Continuous:	(Timer Bypass)
Automatic stop:	When time reaches "0" the output is disabled and countdown stops.

PRECAUTIONS

1. Line supply voltage is present inside the enclosure, and present on exposed components after back housing is removed and line cord is connected to the line supply. DISCONNECT LINE CORD PRIOR TO REMOVING BACK COVER.
2. Servicing should be performed by qualified technicians using appropriate calibrated test equipment.
3. Use grounded wall outlets only.
4. Adhere to standard safety practices for troubleshooting and servicing electronic equipment.
5. To insure continued conformance to specifications and applicable safety standards, the Sys*Stim 206A should be performance checked and safety tested at least once each year.
6. USE OF CONTROLS OR ADJUSTMENTS OR PERFORMANCE OF PROCEDURES OTHER THAN THOSE SPECIFIED HEREIN MAY RESULT IN HAZARDOUS EXPOSURE TO ELECTRICAL ENERGY.
7. Do not operate the Sys*Stim 206A in close proximity with operating shortwave or microwave diathermies.
8. Replace line fuses with same type and rating as specified in the list of specifications and on printed circuit board nest to the fuses to avoid risk of fire and component damage.
9. Primary circuit components must be replaced with factory- specified components to insure compliance with UL-544 safety standard for medical and dental equipment.

EQUIPMENT DESCRIPTION

The Sys*Stim 206A is a portable, microprocessor controlled, digital, dual channel, electrical neuromuscular stimulator that has three pulse modes and a DC Continuous mode. Additional features such as surge options, reciprocation and reverse polarity are also available.

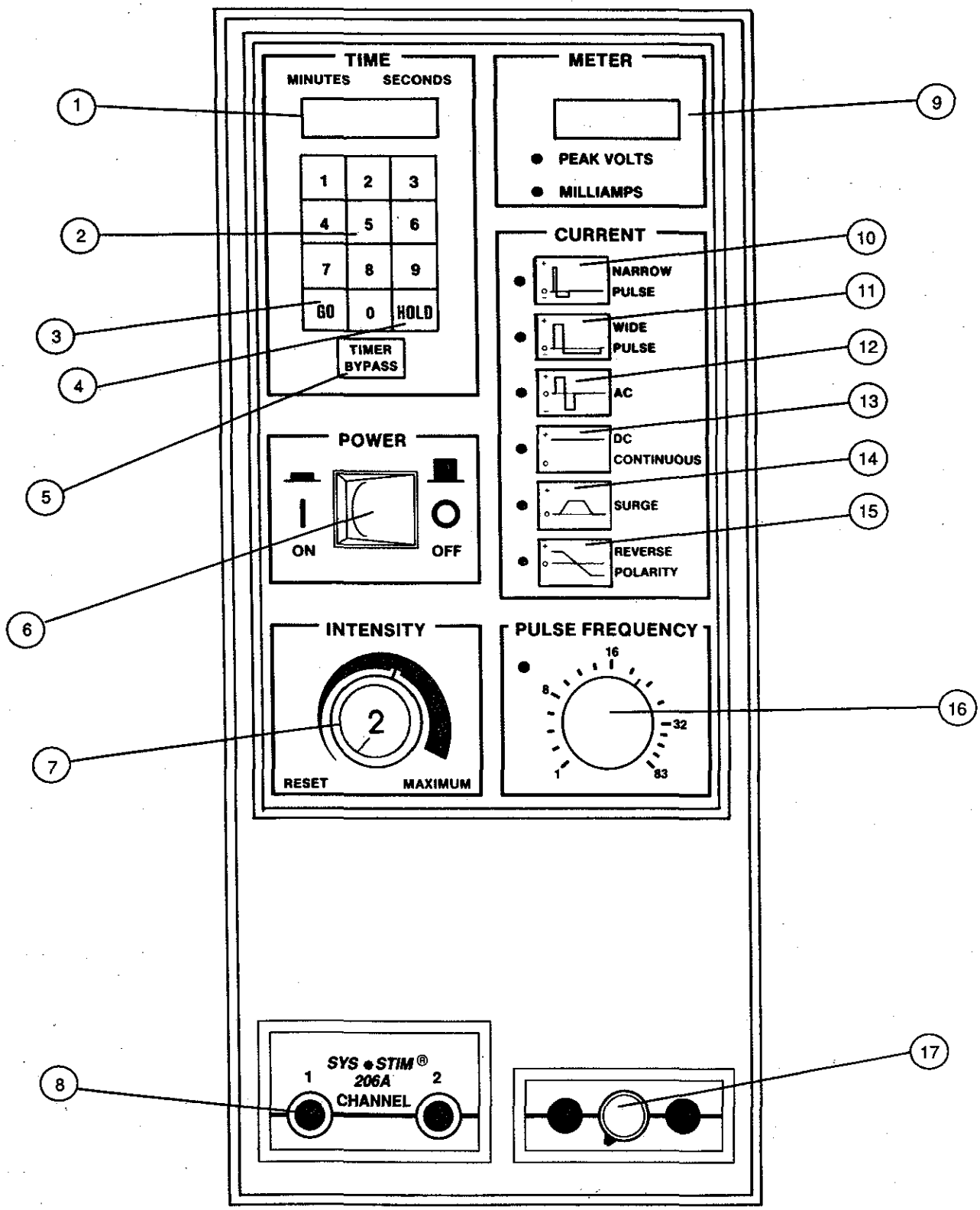
The injection molded ABS plastic enclosure is divided into two halves, a front half and a back half. Electronics circuitry and indicator subassemblies are assembled into the front enclosure half. The back enclosure half provides a protective cover and base that is removed by means of four Phillips head screws.

There are three printed circuit boards in the Sys*Stim 206A: the RFI, Display and Main circuit boards. The RFI board is a small PCB consisting of two fuses and a line filter. The Display and Main circuit boards contain most of the operating and power supply circuits. Each of these subassemblies is described in the Theory of Operation section of this manual.

The membrane touch control panel incorporates multilayer laminated design minimizing knobs and dials, and facilitating equipment operation.

Displays consist of 7-segment LED's, green LED's, and a beeper signal to indicate control operation, end of treatment time, and output cutoff.

The Sys*Stim 206A is constructed and safety tested in compliance with UL-544, "medical and dental equipment standard for safety".



Control and Display Panel

DESCRIPTIONS OF CONTROLS, INDICATORS AND DISPLAYS

1. TIME Display

The TIME display indicates selected time, time remaining and elapsed time. It also displays "On" and "Off" when on/off times are selected for variable surge cycles. "CH2" is displayed for 5 seconds every 30 seconds when channel 2 output is indicated by the METER display.

2. TIME Selector

The TIME selector is a ten key pad. To input 1 minute press "1" to get "1.00" in the time display. For 10 minutes, press "1" then "0" to get "10.00" in the TIME display. From 1 to 29 minutes may be input. Seconds cannot be input, but during operation the TIME display shows time in minutes and seconds.

3. GO

GO starts the output. When pushed, time counts down, the METER display becomes active, and Stimulation current is available at the ELECTRODE JACKS. Both INTENSITY controls must be rotated fully counterclockwise for GO to activate. If time does not begin to change, check position of these controls and adjust accordingly. "Err1" will be displayed if these controls are not returned to the zero position.

4. HOLD

HOLD temporarily suspends operation. Timer is frozen at time remaining, or time elapsed, when HOLD is pressed. METER returns to zero and outputs are terminated. All previously selected parameters are maintained. INTENSITY controls must be returned to zero prior to resuming operation. New operating parameters may be selected while in HOLD.

5. TIMER BYPASS

TIMER BYPASS is used when preset time is not desired. It obviates the need to input time. TIME display shows elapsed time alternating with flashing dashes during operation. Elapsed time is shown in even seconds and restarts at 0.00 after each 100 minute time period.

6. MAIN POWER SWITCH

THE MAIN POWER SWITCH is a rocker type switch which, if depressed to the left, applies power to the unit.

7. INTENSITY CONTROLS

Dual control knobs permit intensity adjustment of both channels. The lower knob adjusts the intensity for channel 1 and the upper knob adjusts the intensity for

channel 2. Both controls must be fully counterclockwise before initiating operation.

8. ELECTRODE JACKS

There are two output jacks marked "1" and "2" to indicate respective output channels.

9. METER DISPLAY

Indicates peak output voltage in the NARROW, WIDE and AC modes; milliamps in the DC CONTINUOUS. PEAK VOLTS and MILLIAMPS green LED's under the METER display indicate which units are displayed. Channel 1 output is displayed except when "CH2" is shown in the TIME display.

Indicates surge codes (L11, L13, H13, P1, P5, P10, etc.) and variable On/Off times in SURGE mode during initial treatment parameter selection. In HOLD, or when timer counts down to zero, the selected SURGE code returns.

10. NARROW PULSE MODE

NARROW PULSE waveform is an asymmetrical biphasic square pulse. Phase duration is 100 microseconds one way, 400 microseconds the other at 1/4 amplitude to provide zero amperes net DC current flow. The green LED next to the NARROW PULSE key is lit when this mode is selected.

11. WIDE PULSE MODE

WIDE PULSE MODE waveform is an asymmetrical biphasic square pulse. Phase duration is 300 microseconds one way, 1200 microseconds the other at 1/4 amplitude to provide zero amperes net DC current flow. The green LED next to the WIDE PULSE key is lit when this mode is selected.

12. AC MODE

AC waveform is a symmetrical biphasic square pulse. Each phase duration is 300 microseconds at equal amplitude, opposite polarity. Net DC current flow is zero amperes. The green LED next to the AC key is lit when this mode is selected.

13. DC CONTINUOUS MODE.

The first time DC CONTINUOUS is selected, output is continuous and in one polarity only. CAUTION: APPLICATION OF CONTINUOUS DC (GALVANIC) CURRENT CAN PRODUCE SKIN IRRITATION. USE EXTREME CARE. Black lead is negative, red lead is positive. Output is displayed in milliamps.

Note: Continuous DC is output through CH 1 only.

14. SURGE CONTROL

Activating SURGE allows the operator to select preset or variable On/Off times of 1-60 seconds for use with NARROW PULSE, WIDE PULSE and AC modes. Activating SURGE with DC CONTINUOUS provides monophasic pulses at three

different phase durations. The green LED next to the SURGE control is lit when SURGE is selected.

Repeatedly press the selected waveform key (NARROW PULSE, AC or DC CONTINUOUS pulsed) until desired surge code is displayed in the METER. A 15 second period is available after treatment is initiated in all surge modes (except DC CONTINUOUS) to allow the operator time to adjust the intensity of the output to the patient. When 15 seconds have elapsed, the intensity will ramp down and the preset Off time will begin the selected surge program. SURGE codes are listed below.

NARROW PULSE, WIDE PULSE AND AC

Code	Up Ramp	On Time	Down Ramp	Off Time	Frequency
F35	3 sec.	6 sec.	3 sec.	18 sec.	35 pps
F83	3 sec.	6 sec.	3 sec.	18 sec.	83 pps
On *	3 sec.	1-60 sec	3 sec.	1-60 sec.	(Use PULSE FREQUENCY control)

Input time with 10-key pad. METER displays ON time. Pressing GO after entering OFF time enables TIME selector and GO key.

*DC CONTINUOUS***

Code	Phase Duration	Maximum Frequency
P1	1 millisecond	83 pps
P5	5 milliseconds	83 pps
P10	10 milliseconds	83 pps

** PULSE FREQUENCY control is enabled in pulsed DC. The waveform is a monophasic square wave.

15. REVERSE POLARITY

Polarity may be reversed at any time before, during or after operation. The LED next to this key indicates normal polarity when off (black = negative). REVERSE POLARITY is enabled when using DC CONTINUOUS, NARROW PULSE and WIDE PULSE.

16. PULSE FREQUENCY CONTROL

This control varies pulse frequency form 1 - 83 pps in all pulsed modes except preprogrammed surge cycles. It is disabled in DC CONTINUOUS. Frequency increases with clockwise rotation. A green LED next to the Frequency control is on when pulse energy is at the output(s) and blinks at a rate proportional to the selected frequency.

17. RECIP OPTION

This option alternates selected pulsed currents between the two channels for 2 to 10 seconds each. A distinctive detent is felt when control is rotated past the on/off point. Setting the desired time at 2 to 10 seconds provides output at CH 1 for that period of time followed by output for the same amount of time on CH 2. Up and down pulse ramps of 0.5 second are provided in RECIP.

RECIP is disabled if SURGE or DC continuous is selected, and can not be disabled after treatment has been initiated.

Rotate RECIP control fully counterclockwise past the distinctive detent when reciprocation is not required.

THEORY OF OPERATION

1. POWER SUPPLY

The power supply consists of a line transformer that supplies AC power to the +5 volt, +12 volt, -12 volt and +40 volt supplies, full wave rectifiers for each of supplies and three 3-terminal regulators for the +5, +12 and -12 supplies. The +40 volt supply is unregulated.

2. CONTROL CIRCUITRY

The control circuitry is made of following sections:

A. Microprocessor, Reset circuit, Crystal and UVEPROM
These parts make up the heart of the microcontroller. The 8 MHz crystal provides the System clock that allows the microcontroller to run and the UVEPROM contains the program firmware that controls the action of the controller. The reset circuit allows the voltage and clock frequencies to stabilize within the microcontroller before allowing it to run the program that is stored in the UVEPROM.

B. 7 Segment Display Driver
The display is controlled by the microprocessor used PORTA and decoder to sequence the display strobes and drives the individual segments from a latch. The output of the latch is connected to high current driver that supplies current to the LED segments. The function indicator LED are also driven in this way.

C. The Membrane Keyboard Interface.
The membrane keyboard is a 7 by 3 switch matrix. The rows are strobed with display strobes 0 through 6 and the columns are monitored by PORTA bits 0, 1 and 2.

D. The Dual D-A Converter
The D-A converters along with the intensity pots for channels 1 and 2 produce an output voltage between 0 and 5 volts for each channel that is used to control the output voltage of the high voltage generator.

E. The 8-Bit Latch
This latch is used to output waveform control signals for both channels and also to output signals to the buzzer and to the frequency indicator LED.

3. HIGH VOLTAGE GENERATOR

The high voltage generator is made up of the following sections:

A. Voltage Controlled Dual Output Power supply
The heart of the output power supply is a switch mode pulse width modulation control chip. The output of the chip switches on a power FET that draws current from the +40 volt unregulated supply through the primary of a step-up transformer. So as the pulse width at the

output of the chip increases, the amount of Power applied to the transformer is increased, thus the voltage produced on the secondary increases and the feedback voltage is increased. The control voltage comes from the D-A converter and the maximum output from the converter is adjusted at setup to cause 102 volts at the patient output. The minimum output is 1 volt.

A ¼ amplitude low voltage output slaved to the high voltage output is provided.

Current control of the supply is limited to 30 mA when the current limit defeat signal from the microcontroller is not present. This limit is active only in the DC mode. The AC pulsed modes can produce pulse currents up to 200 milliamps.

B. HI/LOW Voltage Select Switch
Either one of the power supply voltages can be selected for the patient output with the HI/LOW Voltage Select signal. This signal can turn on a FET switch that connects the higher voltage to the voltage to the patient output or it can turn off the switch so that 1/4 voltage appears at the output.

C. Voltage and Current Sense
Patient applied voltage and current are read by the microprocessor's analog to digital converter inputs, and the binary number that is read by the processor then converted to decimal is the voltage and current that is being sensed.

D. Output Switches
The bridge configuration of the FET switches develops the square wave output and the polarity reversal of the device. Q8 and Q9 for CH1, and Q20 and Q21 for CH2 work together for one current direction while Q5 and Q6 for CH1, and Q17 and Q18 work in the opposite direction. Only one pair for each channel can be on at a time.

OPERATING INSTRUCTIONS

1. Before Starting.
   Review control/display descriptions and precautions. Verify line cord and electrode cable connections.

2. Energize.
   Depress MAIN POWER rocker switch to the left.

3. Reset Intensity.
   Set both intensity controls fully counterclockwise.

4. Input Time
   Select operating time with 10-key pad. Maximum time to enter is 29 minutes. If greater than 29 minutes is entered, "Err2" is displayed in TIME window when GO is pressed. TIME display should show time selected, e.g., if "5" is pressed TIME display shows "5.00". A tone is produced when any key is pressed to verify activation.

   It is not necessary to input a specific time to operate ME 206A. For an indefinite time, select TIMER BYPASS prior to pressing GO.

5. Select waveform.
   Default is NARROW PULSE. Other options include WIDE PULSE, AC and DC CONTINUOUS.

6. Select optional duty cycles.
   Press SURGE or turn on RECIP control to select an On/Off duty cycle. Details of the operational characteristics of each option are shown below.

   SURGE - available in NARROW PULSE, WIDE PULSE, AC, and DC CONTINUOUS. Press waveform switch repeatedly until desired surge code appears in the METER display. SURGE codes are described on page 10, item 15. SURGE sequences are given below.

NARROW PULSE, WIDE PULSE, AC

Press desired mode		
Press SURGE	---------->	F35 in METER
Press mode key	---------->	F83 in METER
Press mode key	---------->	ON in TIME
Enter 1-60 on key pad	---------->	1-60 in METER
Press GO	---------->	OFF in METER
Enter 1-60 on key pad	---------->	1-60 in TIME
Press GO	---------->	TIME shows entered time. METER shows "Adj."

DC CONTINUOUS

Press	---------->	DC CONTINUOUS
Press SURGE	---------->	"P 1" in METER
Press DC CONTINUOUS	---------->	"P 5" in METER

Press DC CONTINUOUS ----------> "P 10" in METER

When desired duty cycle code is displayed, proceed to step 7.

RECIP - rotate RECIP control clockwise to the on position. Reciprocation times of 2-10 seconds may be selected. NARROW PULSE, WIDE PULSE and AC may be selected when RECIP is activated. RECIP cannot be activated at same time SURGE is selected and may not be deactivated during treatment.

7. Select Pulse Frequency
   Set desired frequency using PULSE FREQUENCY knob. PULSE FREQUENCY is active when pulse waveforms are selected, in SURGE ON/OFF program, and in RECIP. It is disabled in DC CONTINUOUS except for pulse options.

8. Connect Electrode Cables (or dummy loads)
   Attach electrodes to electrode cables by inserting cable pins or banana connectors into electrode jacks. (See TEST PROCEDURE for dummy load description.)

9. Begin Operation
   After all operating parameters are set, press GO.

   "Err1" is displayed if both intensity controls are not adjusted fully counterclockwise. Rotate both intensity controls to reset and press GO to clear error and continue.

   "Err2" is displayed if time greater than 29 minutes is entered. Enter time less than 30 minutes and press GO to clear error and continue.

   "Err4" is displayed if no time entered and TIMER BYPASS not selected.

10. Set Intensity.
    Adjust output intensity to desired level using dual intensity control knobs. Rotate the lower control knob only to adjust Channel 1, and the upper knob for channel 2. DC CONTINUOUS intensity is shown in milliamps. Intensity for all other modes is given in volts. The LED indicators below the METER are lit either to the left of Peak Volts or Milliamps, whichever is being displayed.

11. Operation Interrupt.
    If changes are desired while equipment is running press HOLD to suspend operation. Reset intensity by rotating both intensity controls fully counterclockwise before pressing GO to restart operation.

12. Reversing Polarity
    Electrode polarity may be reversed at any time during operation by pressing the REVERSE POLARITY key. The black electrode will change from negative to positive while the red electrode will change from positive to negative when REVERSE POLARTIY is selected.

13. End of Operation Time
    When operation time elapses, a buzzer will sound. TIME and METER displays return to zero and output terminates.

ROUTINE MAINTENANCE

1. The SYS*STIM 206A may be cleaned with a damp cloth. The line cord should be disconnected before cleaning unit. In case of stubborn dirt, a gentle household cleaner may be sprayed on the cloth and then wiped on the unit. If this method is used, remove cleaner residue with damp cloth.
2. Electrode cables ARE NOT autoclavable.
3. Replace electrodes and cables upon any sign of wear, tear or corrosion to ensure proper operation.
4. Standard electrical safety checks should be performed annually.

FUSE REPLACEMENT

1. Two line fuses located on the RFI board are used. Fuse replacement requires removal of the back enclosure. Use only the same fuse type and rating for replacement to protect against fire hazard.
2. If fuse replacement becomes necessary, the unit should be checked for proper operation prior to placing it back in service.

OPERATOR TROUBLESHOOTING

SYMPTOM	CHECK
1. Nothing lights when main power switch is turned on.	Is line cord connected to outlet?
2. When GO is pressed nothing happens; time does not increment down, intensity cannot be adjusted and no output.	Reset the unit. Reprogram treatment parameters. Press GO to restart up or operation.
3. In DC CONTINUOUS, when GO is pressed, time increments up or down, but intensity cannot be adjusted.	Verify electrode cable connections, or dummy loads in properly. and no output.
4. During operation, previously selected treatment parameters cannot be changed.	This is normal.
5. "Err1" in TIME display.	Reset intensities to zero and press GO.
6. "Err2" in TIME display	More than 29 minutes entered. Enter correct time or press TIMER BYPASS and press GO.

7.	"Err3" in TIME display.	On/Off time more than 60 seconds entered. Enter time < 60 seconds.
8.	"Err4" in TIME display.	No time entered. Enter time or press TIMER BYPASS and press GO.

Refer to test procedure for other error codes. If problem is not addressed above, or if additional troubleshooting guidance is desired, call (800)854-9305.

The distributor who sold the Sys*Stim 206A should be able to assist you with a loaner unit during warranty service.

TEST AND CALIBRATION PROCEDURE

Equipment/Material Needed

1. 5 MHz dual channel oscilloscope.
2. DVM
3. 1 kohm/2 W test load.
4. Leakage (safety) tester
5. Hipot tester.
6. EZ-hook to Ez-hook jumpers (2).

1. Procedure:
   Visual Inspection.
   a. Check for signs of damage, poor connections, missing or loose components, reversed components, solder discrepancies, etc.
   b. Look for discoloration of components and PCB's caused by overheating or short circuits.
   c. Look for loose or missing hardware.

2. Power supply.
   a. Verify proper interconnection between PCB assembly and front case.
   b. Set intensity to minimum and frequency to maximum.
   c. Plug unit in and turn it on.
      (1) TP1 and TP4 should be +5 VDC $\pm$ 0.3.
      (2) TP2 should be +12 VDC $\pm$ 0.3.
      (3) TP3 should be -12 VDC $\pm$ 0.3.
      (4) TP5 and TP6 are ground.
   d. Turn unit off.

3. Current Limit
   a. Perform the following for each channel. Before testing CH2, press hidden button #1 (located one inch to right of Current LED) twice to be in test mode and turn RECIP pot on.
      (1) Install 1k load in series with not load mono plug. Put DVM across patient output; red probe to center, black probe to outside.
      (2) Press hidden button #1 twice, press DC CONTINUOUS, enter time, and press GO.
      (3) Set Voltage adjust pot's, R26 (CH1), R89 (RH2) to mid- position.
      (4) Put DVM in DCA mode, 200 mA range.
      (5) Slowly increase intensity to maximum.
      (6) Observe DVM and front panel meter.

(7) Set current adjust pot's, R33 (CH1) and R97 (CH2), for 30 mA ± .2 V on DVM.

(8) Decrease intensity to minimum, jumper R66 (CH1) and R116 (CH2), then slowly increase intensity until over-current circuit is triggered. Shutdown should occur prior to reaching 75 mA. Err5 is displayed in time display. Turn unit off and remove jumpers.

(9) Turn unit on, press hidden button #1 twice and set intensity to maximum. Check for 30 mA on DVM in DC CONTINUOUS.

(10) Adjust current sense pot's, R62 (CH1) and R113 (CH2) for 30 mA on front panel meter.

b. Voltage Adjust. (Perform this test one for each channel.)

(1) Press HOLD. Select NARROW PULSE. Install 1 kohm/2 W load in output jack. Press GO and set intensity to maximum.

(2) Connect scope across output load. Set AMPL/DIV to 20 V and time/DIV to .2\1 ms.

(3) Adjust R26 (CH1) and R89 (CH2) for 102 V ± 2 V peak on oscilloscope.

(4) Adjust R42 (CH1) and R106 (CH2) for 102 V ± 2 V on front panel meter.

4. Waveform Verification. (Perform this test once per channel)

a. Select NARROW PULSE. Set oscilloscope TIME/DIV to 2 ms. Verify pulse interval, leading edge to leading edge, is about 8 ms (28 ms for 35 Hz).

b. Set frequency to minimum. Verify pulse interval is about 1 ms.

c. Refer to Figures 1 through 6 for pulse mode diagrams. Set oscilloscope time/div to .1 ms when checking pulse 1, .2 ms for pulses 2 and 3, 1 ms for pulse 4, and 2 ms for pulses 5 and 6.

d. Select each pulse mode and set intensity to maximum. Verify pulse widths and amplitudes conform to applicable figure (1 through 6) for each mode.

e. Press HOLD. Decrease intensity. Press SURGE, NARROW PULSE and GO.

f. Set intensity to maximum and verify pulses come up and remain for a 15 second adjustment period. Also verify that intensity linearity and amplitude are the same in SURGE as they are in regular pulse modes. Verify SURGE envelope (35 and 83 Hz) agrees with timing table below. Use a timepiece with a second hand to obtain applicable ratios and frequencies.

RATIO	CODE	FREQ	UP RAMP	ON	DOWN RAMP	OFF
1:3	F35	35 Hz	3 S	6 S	3 S	18 S
1:3	F83	83 Hz	3 S	6 S	3 S	18 S

Table 1 Timing.

5. Channel Reciprocation Test.
   a. Set oscilloscope to dual trace and chop mode
   b. Select a pulse mode. Install 1 kohm test load in both output jacks. Check RECIP pot off (fully counter- clockwise). Turn both intensity knobs and frequency knob to maximum. Channel 2 output pulse should follow channel 1 pulse, but never at the same time.
   c. Turn RECIP pot clockwise until it just clicks on. The output pulse should alternate from channel 1 to channel 2 at a 2 second rate.
   d. Turn RECIP pot fully clockwise. The rate at which channels alternate should decrease to a 10 second rate.

6. Front Panel Functions
   a. Press HOLD and each mode switch to verify all green LED's work. Buzzer sounds for every membrane and mode key that is pressed.
   b. Alternately press DC CONTINUOUS and AC PULSE. Verify that peak volts indicator LED goes on for AC PULSE and that milliamps indicator LED goes on for DC CONTINUOUS.
   c. Press NARROW pulse mode, TIMER BYPASS, and GO.
   d. Press HOLD and verify that timer and pulses stop.
   e. Turn intensity to minimum, press SURGE and verify ratio indication on power meter. Press GO and verify timer restarts.
   f. Press HOLD and SURGE to get out of SURGE mode. SURGE LED should go out. Press 0, 1 and GO. Verify that timer counts down from 1 minute to 0 and buzzer sounds for last 2 seconds.
   g. Press HOLD and hidden button #1. Time and voltage displays should simultaneously sequence, 1 through 9, while function indicator LED's light in sequence from top to bottom followed by pulse frequency LED. Press HOLD to exit from test mode.
   h. Verify membrane switch and program checksum.
      (1) Press hidden button #2 located directly below hidden button #1.
      (2) Press keys in following sequence: 1,2,3,4,5,6,7,8,9, GO, 0, HOLD, TIMER BYPASS, NARROW PULSE, WIDE PULSE, AC, DC CONTINUOUS, SURGE and REVERSE POLARITY. If test successful, a 4-digit checksum is shown in time display. Use checksum to verify proper program is installed in unit. Exit by pressing HOLD.

i. Turn unit off.

7. Burn in Procedure
   a. Turn unit on and insert shorted load.
   b. Select DC CONTINUOUS and TIMER BYPASS. Set frequency and intensity to maximum.
   c. Verify timer is counting and output is 30 mA ± 5/-1.
   d. Let unit run for a minimum of 30 minutes.
   e. Turn unit off.
8. Hipot Test. (Perform test on both channels.)
   a. Install 2 kohm series loads in outputs and turn unit on.
   b. Clip red hipot lead to two AC terminals on unit power plug.
   c. Clip black hipot lead to ground terminal on unit power plug.
   d. Hipot test to 2500 VAC/60 Hz for 1 second.
   e. Remove black hipot lead from plug and connect to junction of two resistors on test load.
   f. Test to 2500 VAC/60 Hz for 1 second.
9. Leakage Current Test. (Perform test on both channels)
   a. Plug unit into leakage (safety) tester.
   b. Set range scale to 200 micro amps.
   c. Hold red lead on center contact of load connector.
   d. Test for leakage current in following modes: NORMAL and CLOSED, NORMAL and OPEN, REVERSE and CLOSED, and REVERSE and OPEN. Readings must be less than 50 micro amps.
10. Functional Test.
   a. Current check. (Perform test on both channels)
      (1) Press HOLD. Set intensity to minimum. Install no-load plugs and connect ammeter across output.
      (2) Select DC CONTINUOUS, press GO, and slowly increase intensity to maximum.
      (3) Verify DVM and front panel meter both read 30 mA ± .2 mA. If not, adjust R33 (CH1) and R97 (CH2) for 30 mA ± .2 mA on DVM and R62 (CH1) and R113 (CH2) for 30 mA ± .2 mA on front panel meter.
   b. Voltage Check. (Perform test on both channels.)
      (1) Set intensity to minimum and press HOLD. Select NARROW PULSE and install 1 kohm loads.

(2) Press GO and verify front panel reads 102 V ± 2 V.

(3) Put oscilloscope across output and verify peak voltage and pulse shape agree with Figure 1. If not adjust R26 (CH1) and R89 (CH2) for 102 V peak on oscilloscope and R42 (CH1) and R106 (CH2) for 102 V ± 2 V on front panel meter.

11. Error Messages

ERROR CODE	ERROR DESCRIPTION
Err1	One or both intensity pots not set to minimum intensity when GO pressed.
Err2	Treatment time longer than 29 minutes entered.
Err3	ON/OFF time greater than 60 seconds entered in variable surge mode.
Err4	No treatment time entered and BYPASS button not when Go pressed.
Err5	Over-current protection circuit triggered. Unit must be turned off to return to normal.
Err6	"Computer operating properly" check time-out has occurred, and to insure safety, unit was RESET.
Err7	Both channels enabled at same time. System was RESET.
Err8	Brief over-current condition detected, > 35 mA, in one of the DC modes and System was RESET. Unit must be turned off to return to normal.
Err9	Brief over-voltage, > 150 volts, detected. Unit must be turned off to return to normal.
ErrA	One output FET is shorted and unit was RESET. Unit must be turned off to return to normal.
Errb	Current detection circuitry not operating properly, or no load is attached to channel 1 in one of the DC modes. Unit must be turned off to return to normal.

Errc	Output current detected at one of the outputs when output supposed to be off. Unit must be turned off to return to normal.
Errd	A key was pressed out of sequence during keypad test.

Sys*Stim 206A Waveform Diagrams

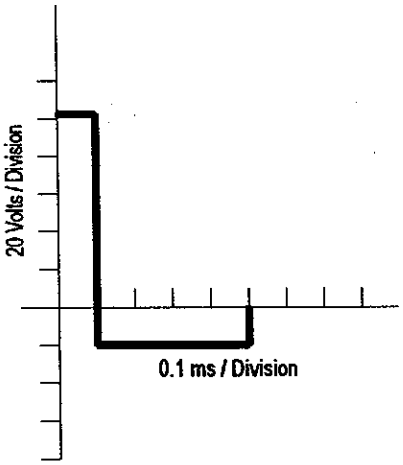


Figure 1—Narrow Pulse

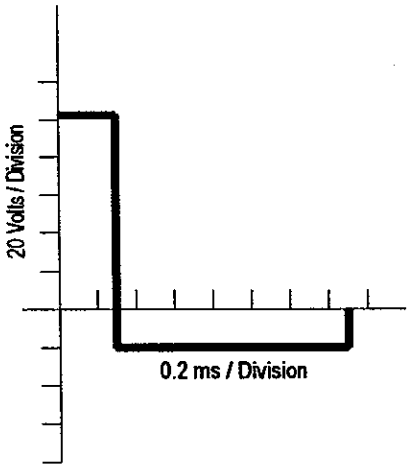


Figure 2—Wide Pulse

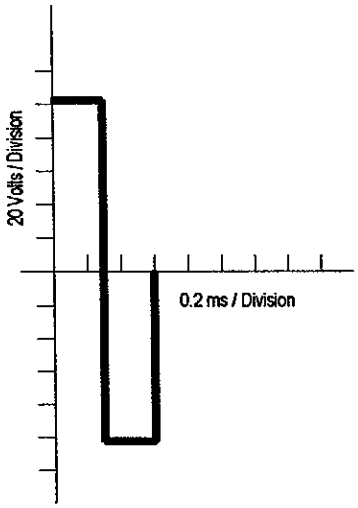


Figure 3—AC Pulse

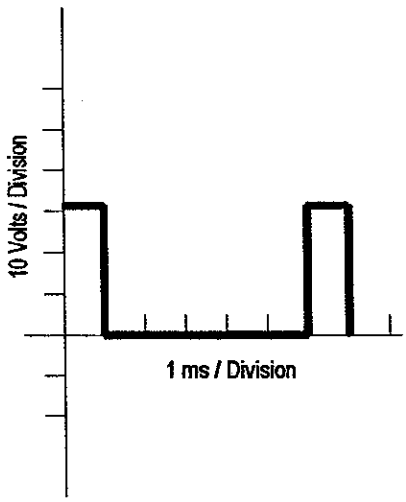


Figure 4—DC Pulse (P1)

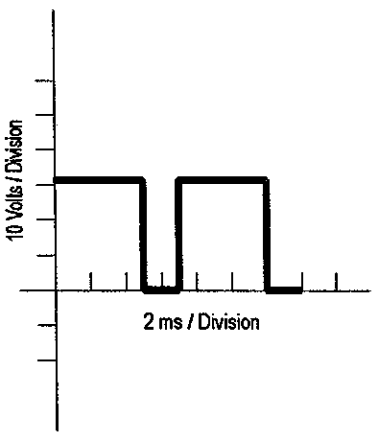


Figure 5—DC Pulse (P5)

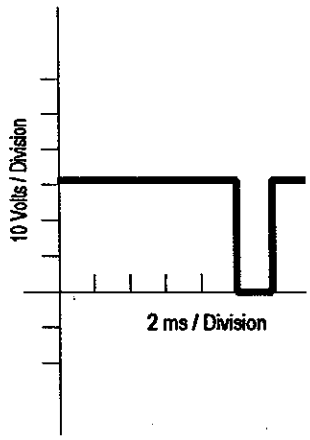


Figure 6—DC Pulse (P10)

Sys*Stim 206A Parts List

Location	Description		Part #
MAIN ASSEMBLIES AND PC BOARDS			
	MAIN BOARD ASSY 206A/207A		QK2-01
	NOTE: ORDER U9 PROGRAMMED EPROM SEPARATE		
	DISPLAY PCB W/CABLE		QK6-01
	FUSE AND RFI PCB 206/207		QK5-05
	HSG, FRONT 206A COMPLETE WITH MEMBRANE		
	SWITCH, STANDOFFS AND LABELS		XK7-05
	HSG, BACK TX COMMON WITH STUD & WASHER BELOW		XH1-15
	HANGER STUD		LB1-08
	WASHER #10 STEEL THIN		JA1-10
	HANDLE, SONICATOR FOG		WKR2-03
	SWITCH MEM. CTRL. PNL - 206		HG1-05
	SWITCH RKR OFF/ON		HH2-01
	POWER CORD ASSY.		QK5-08
	WIRE HARNESS ASSEMBLY (INCLUDES POTS,		QK5-15
	LED's & CONNECTOR, SEE PARTS BELOW)		
	RECIP. LED's GRN (2 REQ)		NB1-01
	RECIP. CONTROL POT. 5K 2W		BD5-06
	PULSE FREQ. POT 5K 2W		BD5-02
	INTENSITY DUAL POT 5K 2W		BD5-07
	WIRE HARNESS & PLUG ONLY		QK5-14
	CABLE ASSY PAT OUTPUT(ORDER NUT BELOW-2 REQ)		QK5-03
	NUT, NYLON 3/8 - 27		EC2-02A
	TRANSFORMER WITH WIRE HARNESS		QK4-02
	TRANSFORMER, POWER		DF1-10
	TRANSFORMER WIRE HARNESS ONLY		QK5-18
	RFI PCB TO SWITCH HARNESS		QO3-12
MISCELLANEOUS PARTS (NOT ON PCB's)			
	LED's HOLDERS (RECIP. LED's)		EC8-01
	CLAMP CABLE 2-PC	MALE	GB1-08
	--ORDER BOTH PARTS	FEMALE	GB1-07
	SHIELD TOP (REAR COVER)		LJ3-04
	CSA CENTER SHIELD (CANADA ONLY)		LJ3-01
	SHIELD, BOTTOM (REAR COVER)		LJ3-05
	LABEL, WARNING HAZ ELEC OUTPUT		PA1-35
	LABEL, RECIP. PANEL		PA1-93
	LABEL, ELECTRODE JACK/LOGO		PA1-92
	STANDOFF 8-32 X 2 5/16		KL1-01
	KNOB, PULSE FREQUENCY		KD1-06
	KNOB, SMALL RECIPROCAL		KD1-14
	KNOB DUAL (SET OF 2) INTENSITY		KD1-13

Location	Description	Part #
	MISCELLANEOUS PARTS (NOT ON PCB's), CONT'D	
	NUT PHONE JACK	JC9-01
	SCREW 8-32 X 1 3/4 PAN	JB3-09
	SCREW 8-32 X 3/4 PAN	JB3-08
	WASHER 3/8 IT	JA3-05
	WASHER #8 IT	JA3-03
	WASHER 3/8 X .62 FLAT	JA1-02
MAIN PRINTED CIRCUIT BOARD PARTS		
CAPACITORS		
C2,3,34,42,65, 73	CAP 50V CERAMIC DISK 27PF	CB1-06
C43,74	CAP 50V CERAMIC DISK 47PF	CB2-09
C19,20,36,39,49 50,67,70	CAP 50V CERAMIC DISK 150PF	CB2-19
C46,75	CAP 50V CERAMIC DISK 220PF	CB2-13
C41,38,69,72	CAP 500V CERAMIC DISK 270PF	CD2-08
C21,51	CAP 50V CERAMIC DISK 470PF	CB2-12
C47,63	CAP 500V CERAMIC DISK 820PF	CA1-03
C26,55	CAP 500V MICA 1000PF	CA1-01
C40,37,68,71	CAP 100V POLYCARBONATE 4700PF	CC2-10
C9-14,25,28,29, 30,33,44,54,57, 58,60,64,78, 79,80	CAP 50V MONOLITHIC CERAMIC 0.02UF	CB2-35
C31,61	CAP 50V CERAMIC DISK 0.02UF	CB2-10
C83,32,62,81,82 100-115	CAP 50V MONOLITHIC CERAMIC 0.1UF	CB1-36
C27,56	CAP 100V POLYCARBONATE 0.1UF	CA1-11
C24,53	CAP 50V RADIAL ELECTROLYTIC 1UF	CC1-01
C15,4,16,17	CAP 16V RADIAL TANTALUM 10UF	CE2-03
C35,48,59,66	CAP 50V RADIAL ELECTROLYTIC 10UF	CD2-18
C23,76	CAP 500V POLYESTER FILM 0.1UF	CB2-14
C18	CAP 50V AXIAL ELECTROLYTIC 100UF	CD2-14
USED ON C18	CLEAR SHRINK TUBING	KP2-01
C6	CAP 10V AXIAL ELECTROLYTIC 3300UF,(SEE BELOW)	CD2-15
C7,8	CAP 35V AXIAL ELECTROLYTIC 680UF,(SEE BELOW)	CD2-16
C22,52	CAP 160V AXIAL ELECTROLYTIC 33UF,(SEE BELOW)	CD2-39
USED ON C6,7,8, 22,52	CLEAR SHRINK TUBING	KB2-02

Location	Description	Part #
RESISTORS AND POTENTIOMETERS		
R44,108	RES. 1W 5% 10 OHM	BC4-03
R134,135	RES. 1/2W 5% 270 OHM	BB3-10
R23,83	RES. 1/2W 5% 330 OHM	BC3-15
R29,92	RES. 1/4W 1% 619	BC2-83
R11,71	RES. 1/4W 5% 1.2K	BC2-22
R68,115,6	RES. 1/2W 5% 2.2K	BC3-17
R32,96	RES. 1/4W 5% 4.7K	BC22-39
R13,73	RES. 1/4W 1% 6.19K	BC2-85
R2,3,5,19,24 45,48,61,63,65 67,79,84,86,87 95,114,126,129 131,132,133, 136		
138,139,140	RES. 1/4W 5% 10K	BC22-42
R31,94	RES. 1/4W 5% 11K	BC2-15
R8,28,37,39,59 60,91,101,103		
109 - 111	RES. 1/4W 5% 12K	BC22-01
R17,77	RES. 1/4W 1% 20.0K	BC2-24
R47,25,88,128	RES. 1/4W 5% 20K	BC22-02
R104,15,75	RES. 1/4W 5% 22K	BC22-03
R40	RES. 1/4W 1% 22.1K	BH2-21
R21,81	RES. 1/4W 1% 24.9K	BC2-23
R27,30,90,93	RES. 1/4W 5% 27K	BC22-05
R7,9,10,22,34, 35 36,38,69,70,82 98,99,100,102		
112	RES. 1/4W 5% 47K	BC2-09
R14,74	RES. 1/4W 5% 51K	BC22-07
R66,116	RES. 1/4W 5% 68K	BC22-09
R12,72	RES. 1/4W 1% 76.8K	BC2-21
R41,105	RES. 1/4W 5% 100K OHM	BC22-10
R18,78	RES. 1/4W 5% 200K OHM	BC22-13
R64,85	RES. 1/4W 5% 220K OHM	BC2-16
R20,80	RES. 1/4W 1% 255K OHM	BC2-17
R49,130	RES. 1/4W 5% 470K OHM	BC2-19
R16,43,76,107	RES. 1/4W 1% 1.00M OHM	BC22-18
R46,127	RES. 1/4W 5% 2.4M OHM	BC2-58
R137	RES. 1/4W 5% 10M OHM	BC2-92
R33,97	POT 1W 500 OHM	BD5-04
R62,26,89,113	POT 1/2W PCMT 5K OHM	BD2-03
R42,106	POT 1/2W PCMT 100K OHM	BD2-02

Location	Description	Part #
INTEGRATED CIRCUIT CHIPS		
U9 (IN SOCKET)	PROGRAMMED EPROM (206A)	RD3-02
(U9 SOCKET ONLY)	28 PIN SOCKET	EC7-15
U1 (IN SOCKET)	CONFIGURED MICROCONTROLLER MC68HC11AOFN	RD3-04
(U1 SOCKET ONLY)	52 PIN SOCKET	EC7-14
U5	QUAD 2-INPUT NAND GATE 74HC00	RD2-42
U27,33	QUAD 2-INPUT NAND GATE 74C00	RA1-05
U16	QUAD 2-INPUT NOR GATE 74HC02	RD2-43
U4	HEX SCHMITT TRIGGER INVERTER 74HC14	RD2-44
U10	DUAL 2-4 LINE DEMULTIPLEXER 74HC139	RD2-45
U12	3-8 LINE DEMULTIPLEXER 74HC237	RD2-46
U2,6	OCTAL TRANSPARENT LATCH 74HC373	RD2-47
U7	OCTAL LATCH 74HC374	RD2-48
U3	DUAL 8-BIT D TO A CONVERTER AD7528	RD2-49
U17,13,15	DARLINGTON TRANSISTOR ARRAY ULN2003A	RA1-04
U14	HIGH VOLTAGE DRIVER UDN2981A	RB1-02
U18	DUAL FLIP FLOP 4013	RE1-03
U24,31	SWITCHING REGULATOR I.C. MC34060P	RC1-02
U22,25,28,29,32	DUAL OP-AMP LM358N	RF1-02
U26	QUAD COMPARATOR	RF1-03
U11,19,20,21	SEE DIODE LIST	
VOLTAGE REGULATORS		
VR1	+5 VOLT REGULATOR LM7805	AD1-01
U8	+5 VOLT LOW POWER REGULATOR 78L05	RC2-02
VR2	+12 VOLT REGULATOR LM7812	RC2-03
VR3	-12 VOLT LOW POWER REGULATOR LM79L12	AD1-03
TRANSISTORS		
Q1,4,7,13,16,19	TRANSISTOR BIPOLAR PNP MPSA92	AB5-04
Q3,15	TRANSISTOR BIPOLAR PNP 2N3906	AB2-06
Q10,11	TRANSISTOR BIPOLAR NPN 2N2222A	AB1-01
Q8,5,17,20	POWER FET P-TYPE VP0540N3	AB6-01
Q2,6,9,14,18,21	POWER FET N-TYPE VN0540N3	AB6-02
Q12,22	TMOS FET SWITCH N-TYPE IRFD110	AB6-03
DIODES		
D9,1,10-16	DIODE 50V 1N4001	AA2-05
D40,37,63,66	DIODE 400V IN4004	AA2-04
D17,35,36,38,39		

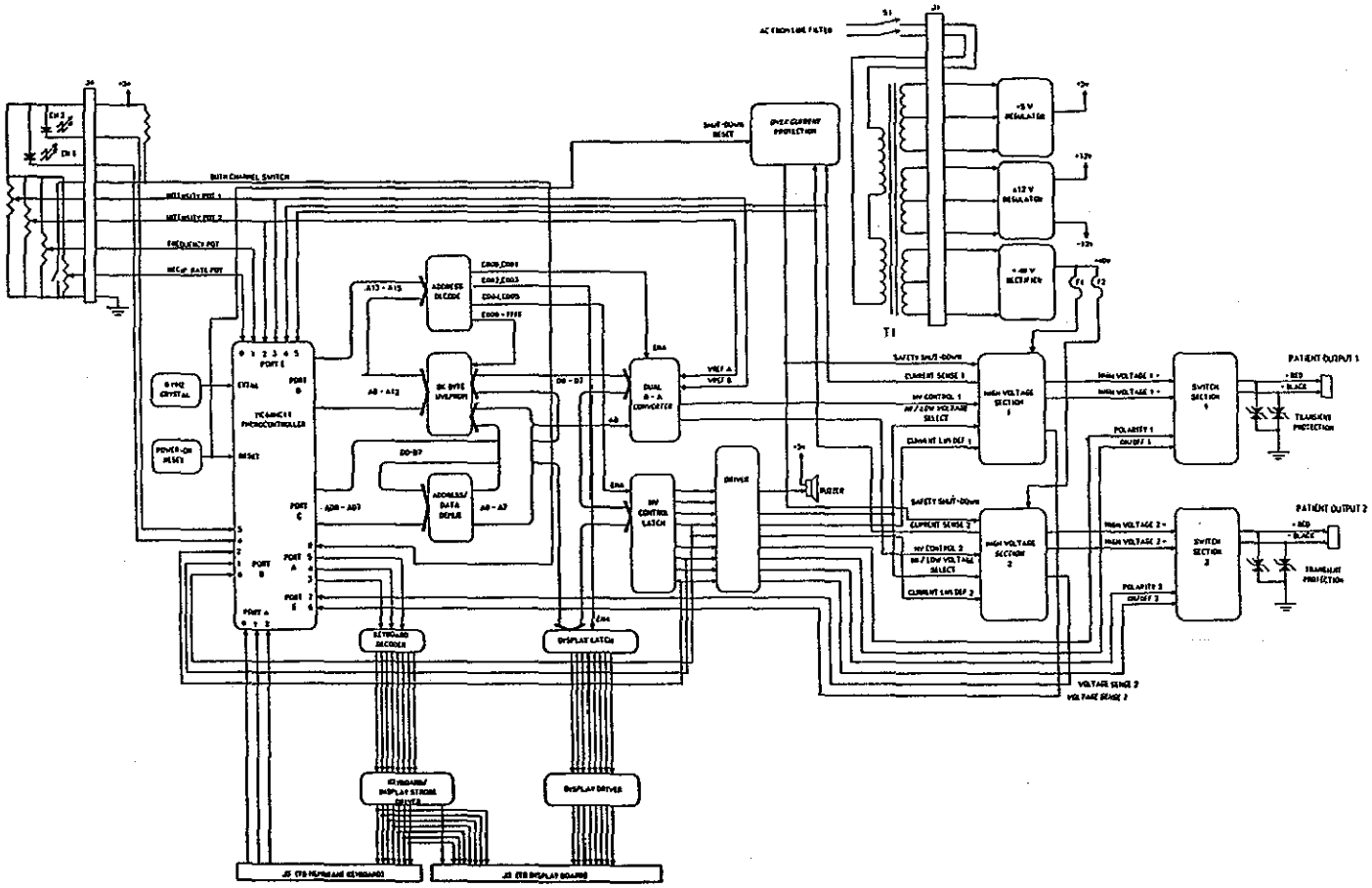
Location	Description	Part #
DIODES CONTINUED		
43,61,62,64,65	ZENER DIODE 12V IN759A	AA2-03
D34,60	FAST RECOVERY RECT. 200V IN4935	AA1-09
D8,2,3,4,5,6,7	SCHOTTKY RECT. 20V MBR030	AB6-09
D42,32,33,58,59		
67	FAST RECOVERY RECT 800V MR817	AA1-04
U11,19,20,21	16 PIN DIODE ARRAY TND907	AA2-11
CONNECTORS		
J1	HEADER 20 PIN FRLCK .156" ORDER 2	ED4-07
J5,6	HEADER 3 PIN FRLCK .156"	ED4-02
J3	HEADER 12 PIN SGL .100" CLIP PIN 8	ED4-06
J2	HEADER 26 PIN DUAL .100"	ED4-08
J4	HEADER 10 PIN DUAL .100"	EC4-25
MISCELLANEOUS PARTS		
X1	8 MHz CRYSTAL	AF1-02
T1,2	POTTED COIL ASSY. HV XFMR (SEE BELOW)	QK1-09
USED ON T1,2	8-32 X 1" NYLON SCREW	JB3-10
USED ON T1,2	8-32 NYLON HEX NUT	JC3-02
TR1-TR4	170V BI-DIRECTIONAL TRANSIENT SUPPRESSER 1.5KE17OCA	AD3-02
BZ1	DC BUZZER	SB1-02
TP1-TP6	TEST TURRET	EC3-02
	CUP STANDOFF	LH1-07
DISPLAY PC BOARD PARTS		
R117	RES. 300 OHM 1/4W, 5%	BC22-25
R109-116	RES. 160 OHM 1/4W, 5%	BC22-23
R101-108	RES. 82 DHM, 1/4W, 5%	BC2-37
DS1-07	DISPLAY 7 SEG. DIGITAL RED (SEE BELOW)	NB2-01
(DS1-07)	SOCKET IC 14 PIN FOR ABOVE	EC7-02
LED 101-109	LED HIGH INTENSITY GRN (SEE BELOW)	NB1-01
(LED 101-109)	SPACER LED SMALL	KK1-04
JPR101	JUMPER 9 CONDUCTOR	TD3-03
CA101	CABLE ASSY RAINBOW	TD3-02
FUSE/RFI BOARD PARTS		
F1,2	FUSE 1 AMP 3AG 250V	FB1-01
(F1,2)	FUSE CLIP PC MNT 1/4"	FC2-02
T1	TRANSFORMER CUP CORE RF1	DA2-04

Location	Description	Part #
FUSE/RFI BOARD PARTS, CONT'D		
C56,57	CAP 2000 PF 500V	CA1-12
(T1)	NUT 4-40 NYLON	JB1-10
(T1)	SCREW 4-40 NYLON	JB1-13
	FISH PAPER COVER	KN1-09
	LABEL WARNING	PA1-18
C58,59	CAP 470PF 3KU	CB1-37

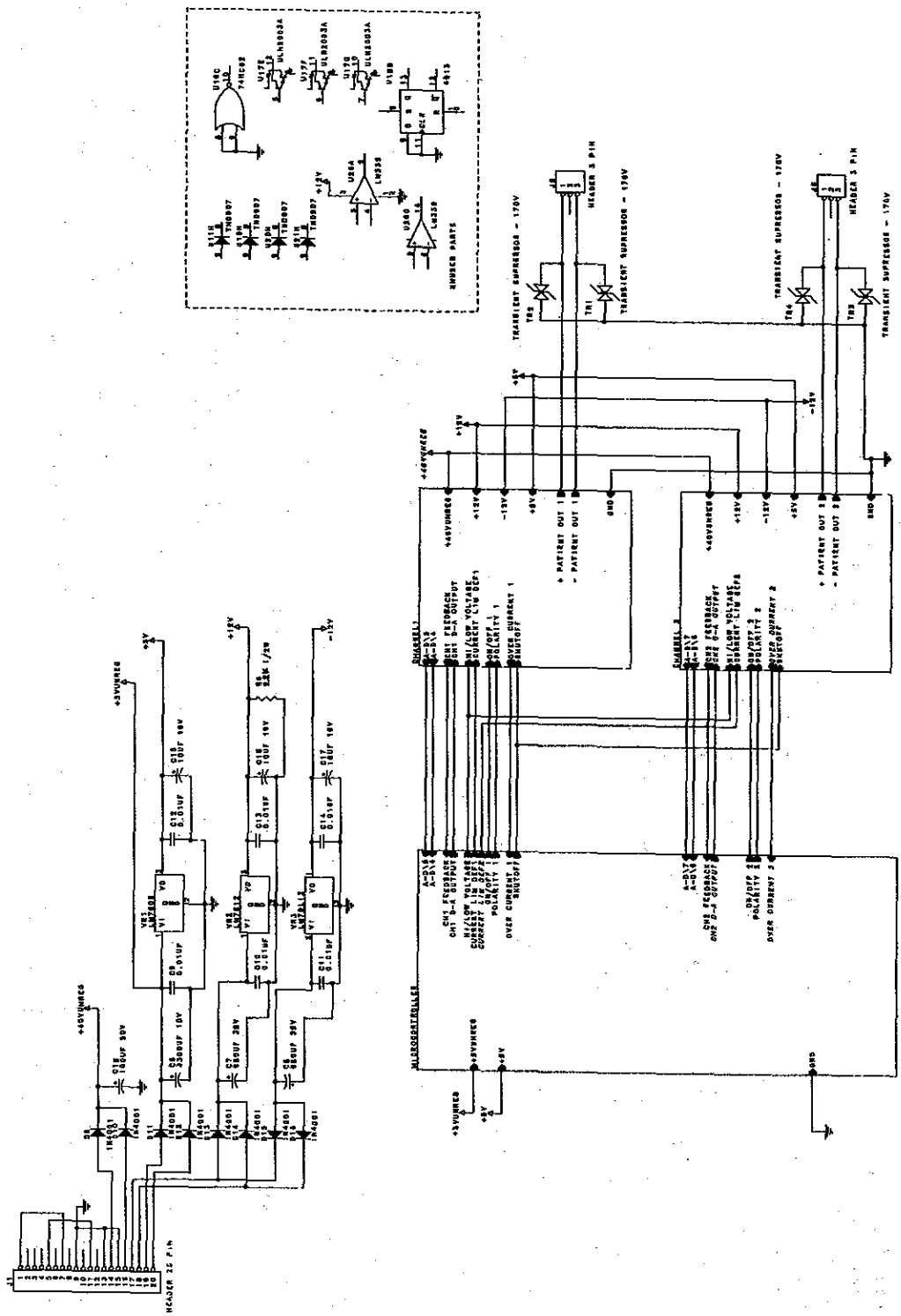
Sys*Stim 206A Accessory List

Catalog #	Description
ME 1004	Wall bracket and screws for wall mounting the Sys*Stim 206A
ME 72	Mobile cabinet - can hold either the Sonicator 705, 706, 710 or 720 with the Sys*Stim 206A, side by side, two units only.
ME 100	Tote bag (Fits the Sonicator 705, 706, 710 or 720 or, the Sys*Stim 220, 206A or 207A or the ME 200).
ME 2000	Pad complete (2" X 2"). Includes rubber cover, stainless steel insert. Package of 4.
ME 2001	Sponge inserts (2" X 2"). Package of 24.
ME 2002	Pad complete (4" X 4"). Includes rubber cover and stainless steel insert. Package of 4.
ME 2003	Sponge inserts (4" X 4"). Package of 24.
ME 2004	Pad complete (3 1/2" X 7"). Includes rubber cover, stainless steel insert. Package of 1.
ME 2005	Sponge inserts (3 1/2" X 7"). Package of 12.
ME 2006	Pad complete (8" X 10"). Includes rubber cover and stainless steel insert. Package of 1.
ME 2007	Sponge inserts (8" X 10"). Package of 12.
ME 2008	Electrode strap (24"). Package of 4.
ME 2009	Electrode strap (48"). Package of 4.
ME 2023	Pencil handle electrode with tip control. Includes 4 stainless spot electrode tips and carrying case.
ME 2026	Electrode cable set (5 ft.) for ME 206A and 207A. Includes one dual cord set and two pin to banana adapter plugs, one red and one black.
ME 2027	Pin to banana adapter plug set for the Sys*Stim 206A and 207A. Two each red and black.
ME 2028	Banana to pin adapter plug set. Two each red and black.
ME 2029	Electrode cable set (10 ft.) identical to ME 2026 except in length.
ME 2221	EZ Trode® - 2" Round, self-adhering electrodes with lead wires. Bag of 10 packages (4 electrodes/pkg)
ME 2222	EZ Trode - 3" Round, self-adhering electrodes with lead wires. Bag of 10 packages (4 electrodes/pkg)
ME 2223	EZ Trode - 2" X 5". self-adhering electrodes with lead wires. Bag of 10 packages (4 electrodes/pkg)

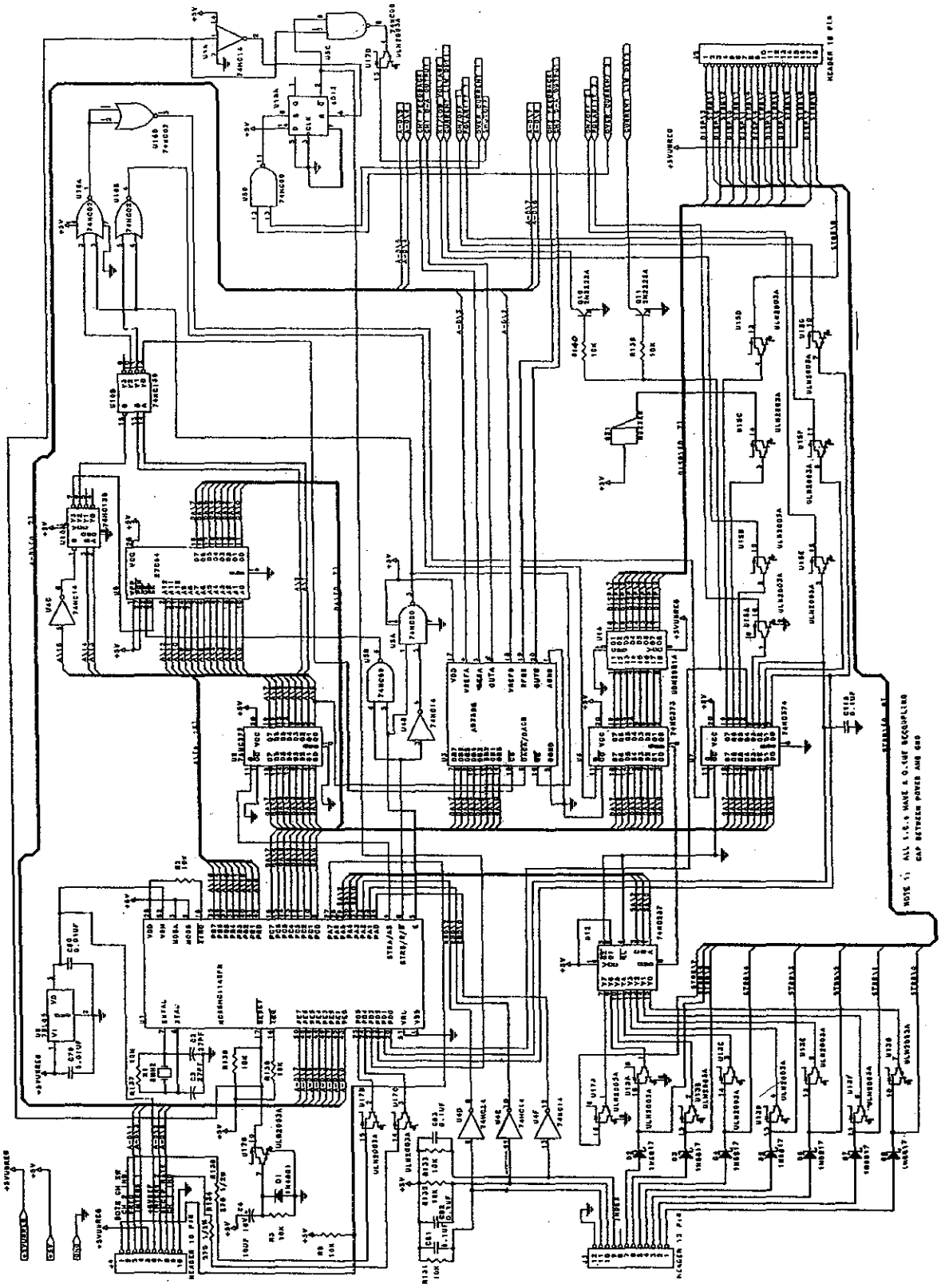
Drawing and Schematics



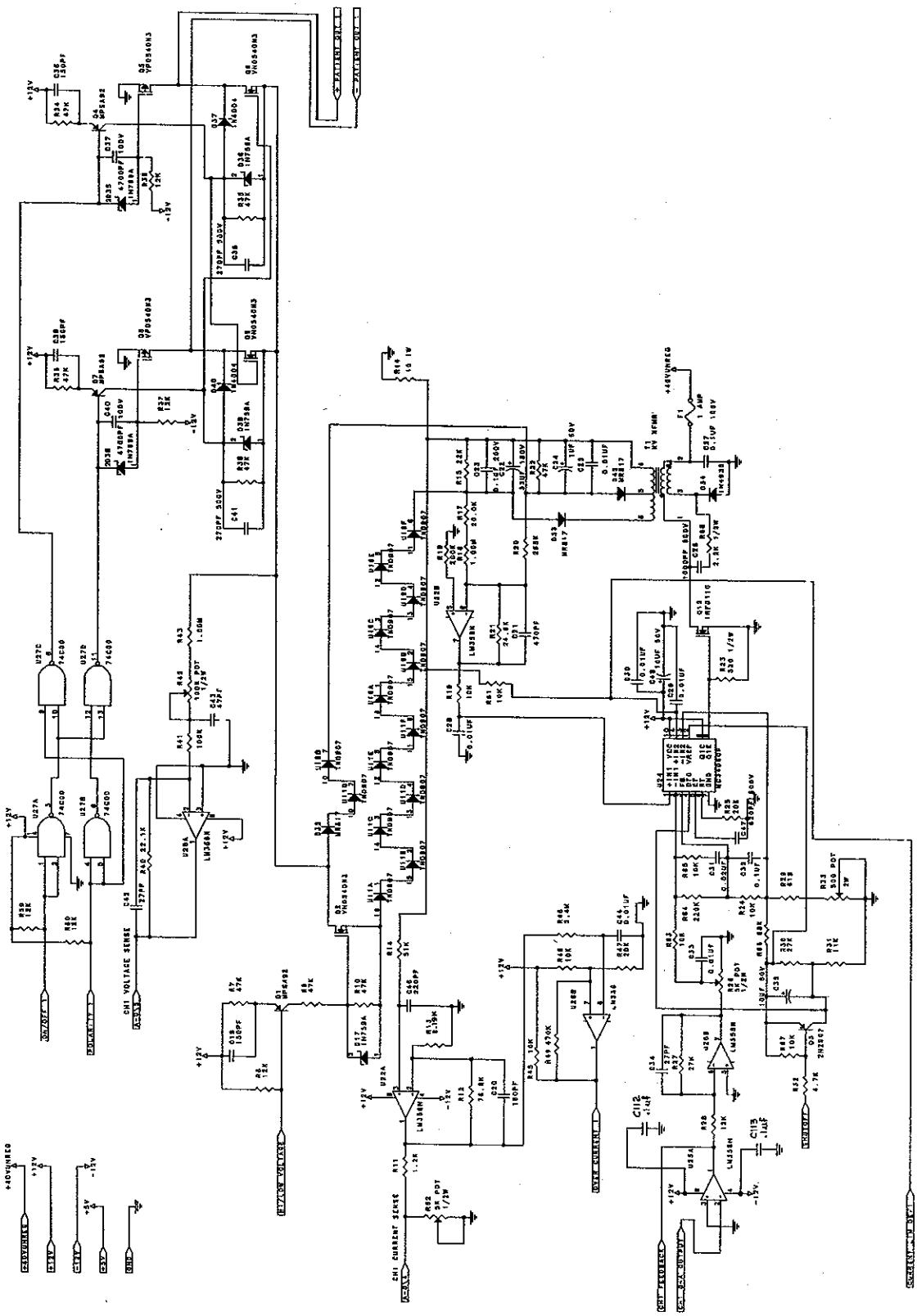
Block Diagram—Main PC Board (11035 A)



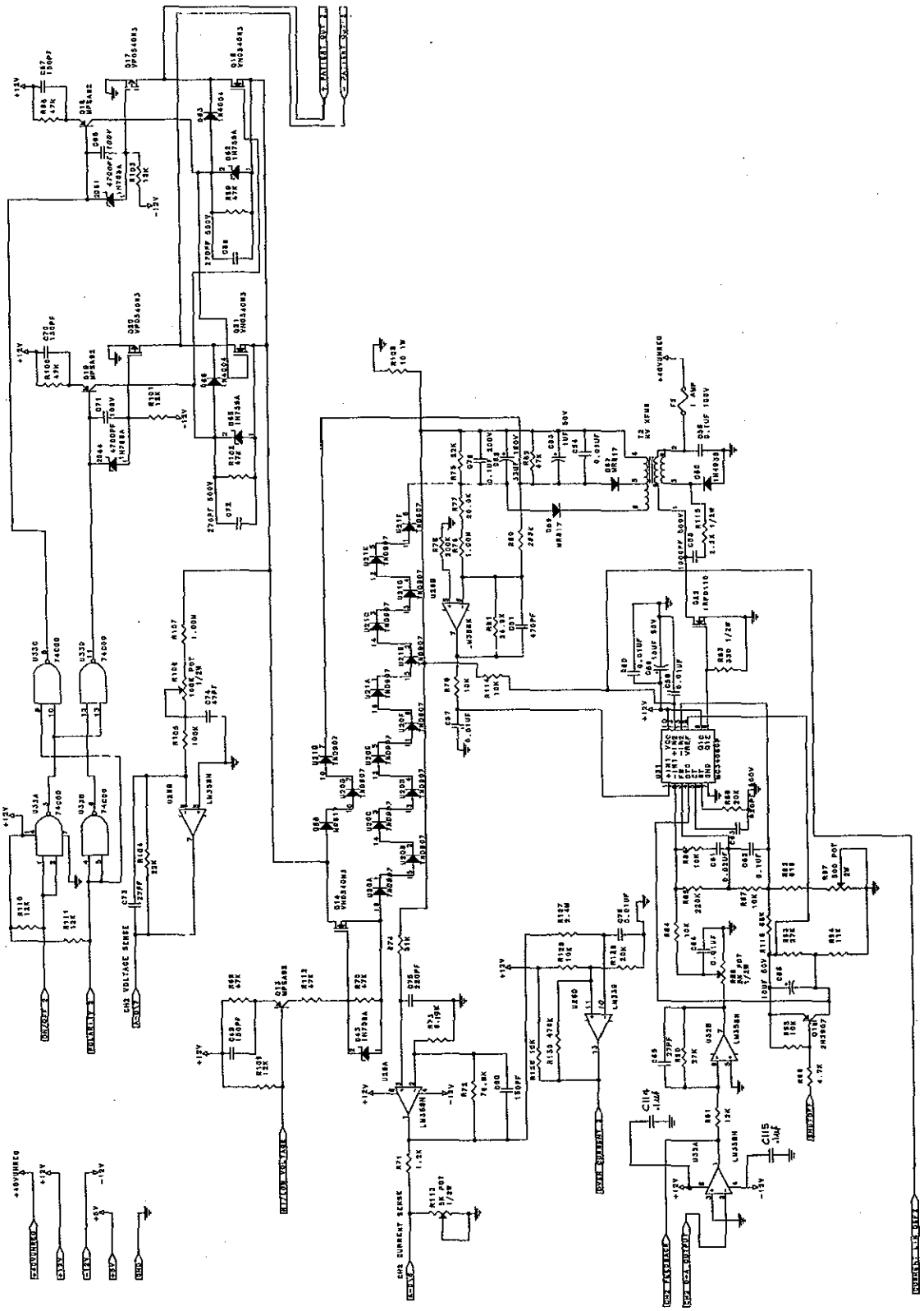
Schematic Diagram—Main PC Board (11029 F) #1 of 4



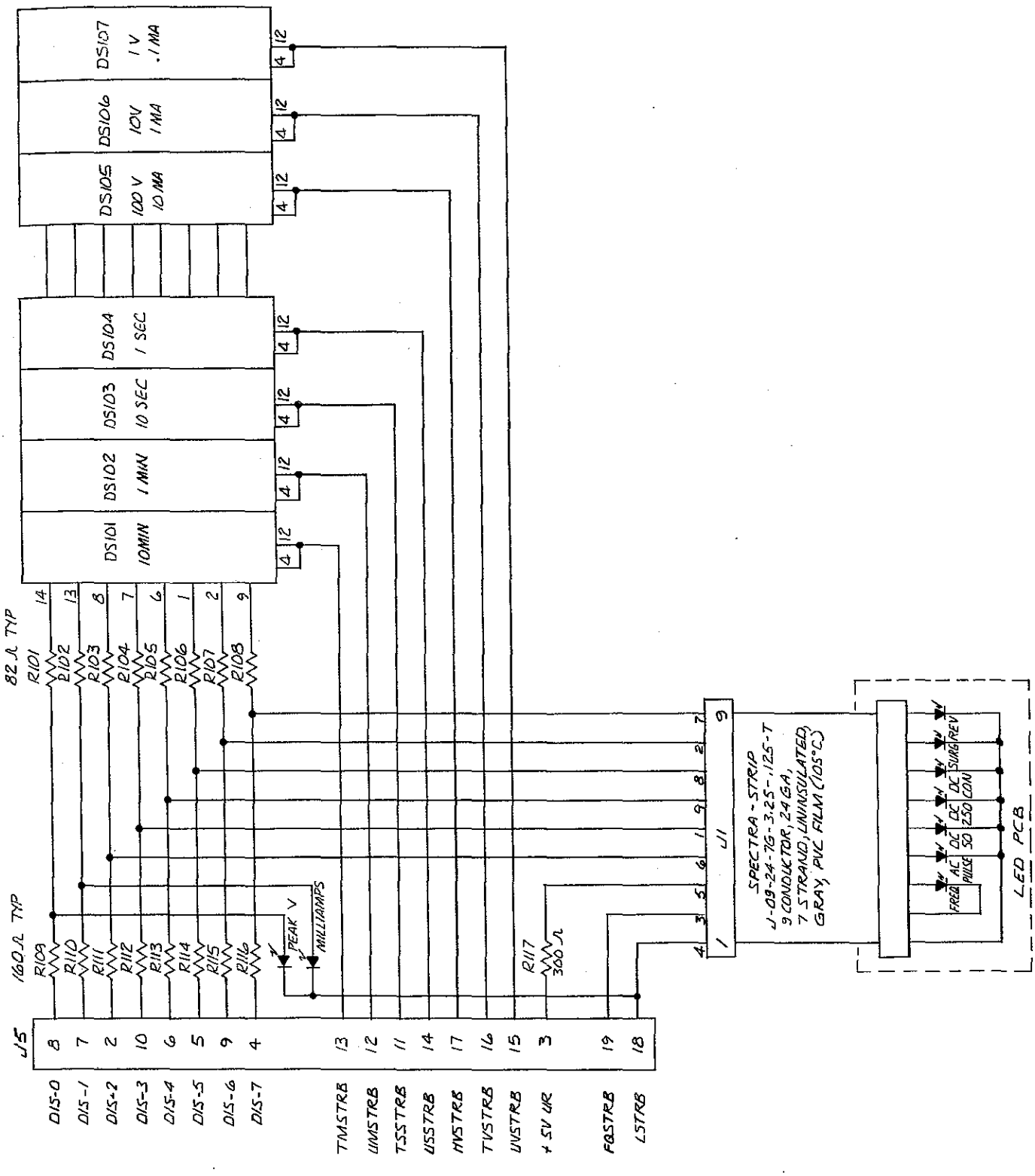
Schematic Diagram—Main PC Board (11029 F) #2 of 4



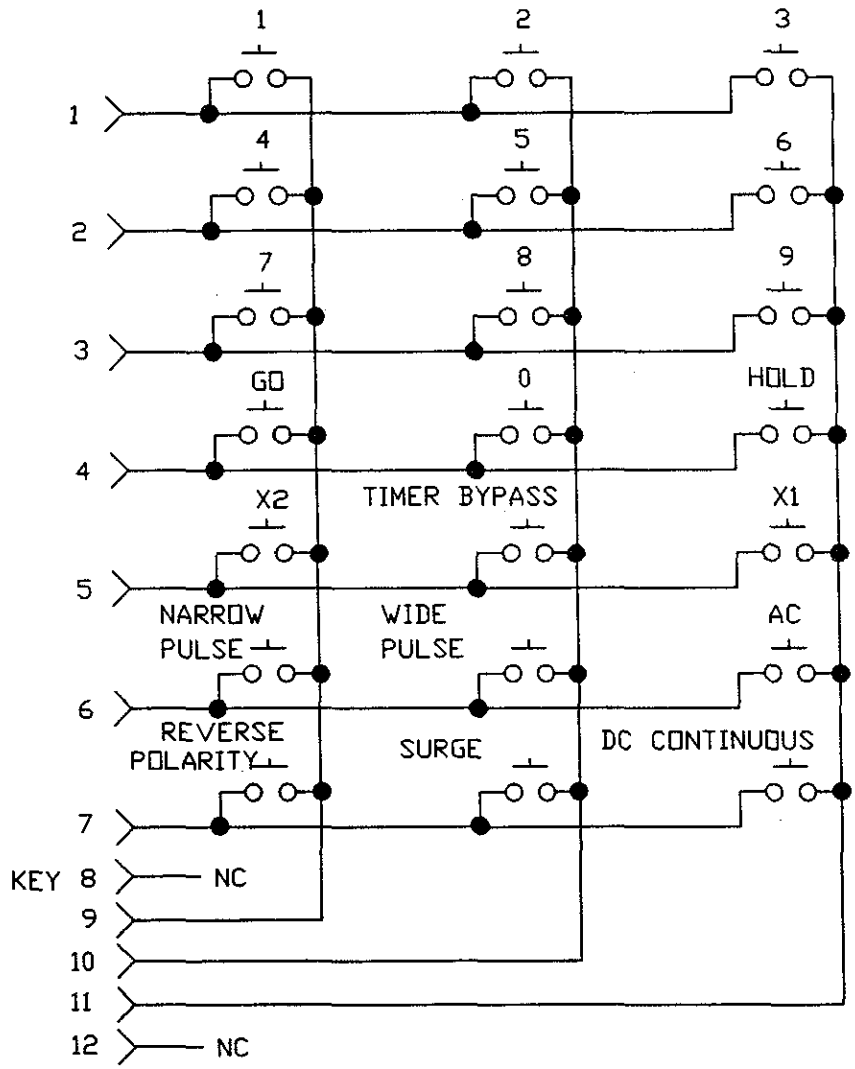
Schematic Diagram—Main PC Board (11029 F) #3 of 4



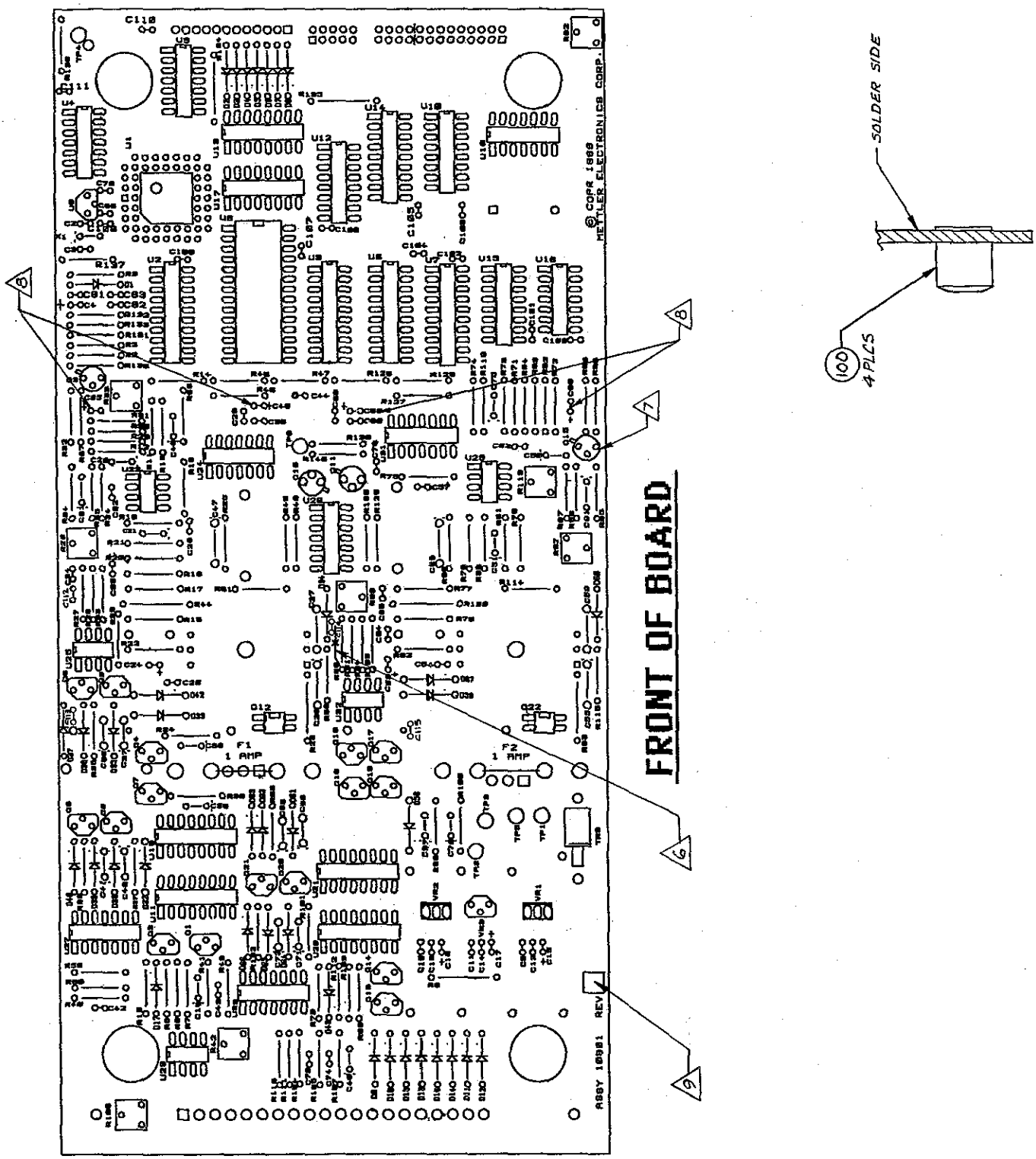
Schematic Diagram—Main PC Board (11029 F) #4 of 4



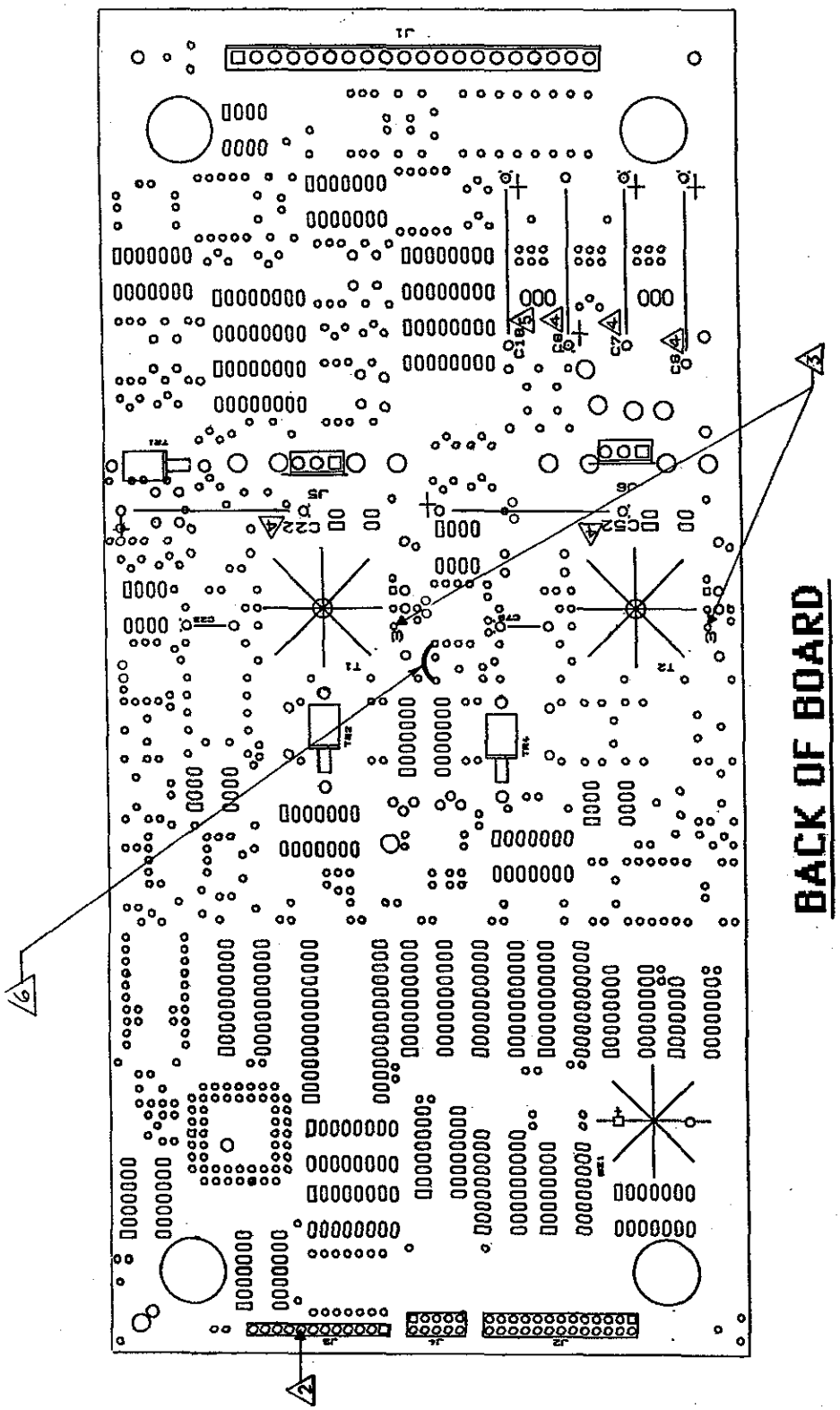
Schematic Diagram—Display Board (10813 B)



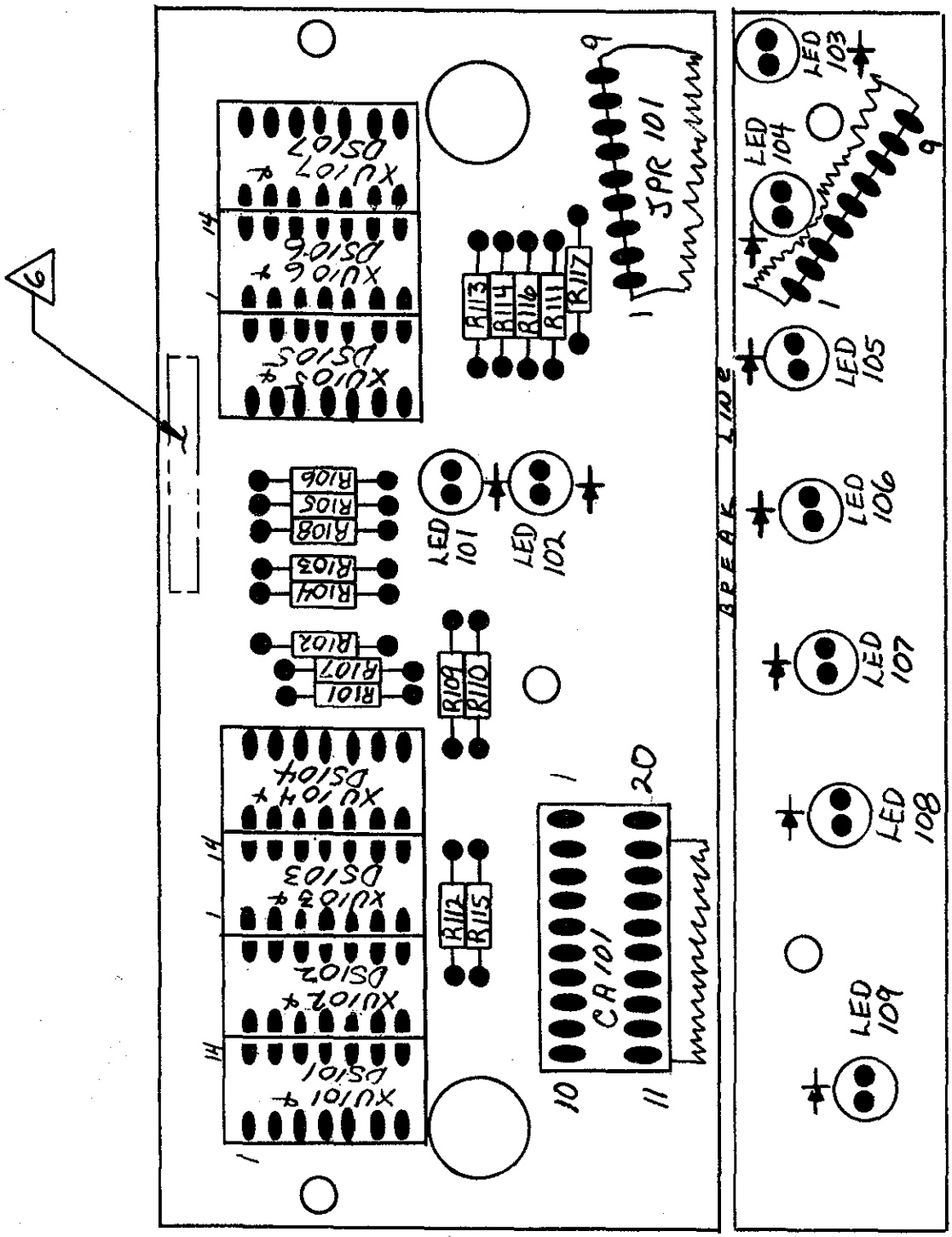
Schematic Diagram— Membrane Switch (10350 A)



Assembly Drawing—Main Board, Front (10901 K)



Assembly Drawing—Main Board, Back (10901 K)



Assembly Drawing—Display Board (10806 D)